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URANIUM HEXAFLUORIDE TECHNOLOGY

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URANIUM HEXAFLUORIDE TECHNOLOGY

PREPARATION OF METAL-GRADE URANIUM TETRAFLUORIDE

The results of laboratory thermobalance, fluid-bed pilot plant, and plant studies with continuous-calciner oxides were discussed with Hanford personnel in a meeting at Paducah. In addition to the poor reactivity, it was pointed out that oxides produced under supposedly identical conditions were quite variable in characteristics, thus making evaluation of test results difficult and preventing optimization of plant operating conditions. The Hanford representatives agreed to look closely at their calcining operation in an attempt to eliminate this variability. Until this problem is solved, all material will be produced with the standard calcining temperature of 270°C.

REMOVAL OF IMPURITIES FROM URANIUM HEXAFLUORIDE

Pilot-plant studies are being made on the removal of volatile impurities from uranium hexafluoride by trapping on solid sorbents. Uranium trioxide spiked with about 100 ppm. of each of the impurities being investigated is converted to uranium hexafluoride in the 4-inch diameter pilot-plant flame reactor. The reactor outlet gas stream passes through a sintered Monel filter and then is divided into two equal streams which flow through parallel sorbent traps. The traps are 3 inches in diameter and have pellet beds about 36 inches deep. In the series of tests just completed, the uranium trioxide contained ruthenium, antimony, arsenic, cadmium, and chromium, and the sorbents were magnesium fluoride and calcium fluoride in the respective traps.

A 26-hour run was made to determine the material balance around the system. Samples of the gas streams collected as a gas or by condensing in nickel cylinders gave variable results. Concentrations of chromium, cadmium, and ruthenium in the uranium hexafluoride ranged from less than 3 to 300 ppm., less than 1 to 5 ppm., and less than 1 to 30 ppm., respectively, in the sorber inlet gas streams. Values for the same impurities in the sorber outlet samples ranged from less than 3 to 300 ppm., less than 1 to 10 ppm., and less than 1 to 10 ppm. Where the chromium concentration was over 15 ppm., the iron content was also high, indicating sample contamination. In no case did the sample analyses indicate that the impurities were consistently leaving the reactor or that the sorbents were effectively decreasing the concentrations. The other two impurities, arsenic and antimony, were not detected in any of the 59 samples analyzed. A liquid sample from a cylinder which contained 400 pounds of uranium hexafluoride collected after the sorbers showed only ruthenium present with a concentration of 12 ppm.

Operation of the reactor was very good during this test, less than 2% of the feed powder was collected in the ash receivers. Spectrographic analyses of the unconverted oxide showed that 30, 58, 47, 46, and 41% of the amounts of arsenic, cadmium, chromium, ruthenium, and antimony, respectively, fed to the tower were present in the ash. In most cases, at least 95% of the impurities found was in the filter ash; the remaining 5% was in the tower ash.

After approximately 530 pounds of uranium hexafluoride had been passed through each sorber at an average rate of 35 pounds per hour, the pellet beds were separated into 6-inch long segments, and each part was analyzed spectrographically. The analytical results showed that ruthenium, at a concentration of 140 ppm., was present only in the top (inlet) section of the calcium fluoride trap. Chromium was present in concentrations of 840 and 150 ppm. in the top two segments of the calcium fluoride and was present throughout the magnesium fluoride, ranging in concentration from 760 ppm. at the top to 100 ppm. at the bottom of the bed. The other elements, cadmium, arsenic, and antimony, were not detected. Since the calcium fluoride and magnesium fluoride bed weights were only 6.2 and 8.5 pounds, the quantity of impurities trapped was insignificant.

It is difficult to interpret the data from the test. Obviously, a large percentage of the impurities was not converted to a volatile fluoride; however, a large amount of the impurities fed cannot be accounted for by sample results. Product uranium hexafluoride samples taken

after the traps showed detectable and quite variable quantities of chromium, cadmium, and ruthenium, but only ruthenium was found in the final product cold trap, possibly indicating that the fluorides or oxyfluorides of chromium and cadmium formed are more volatile than expected and were not condensed in the dry ice-cooled trap.

Further work with these materials is planned. The next series of tests, however, will be with seven other impurities; i.e., titanium, tantalum, tungsten, niobium, molybdenum, vanadium, and zirconium. Eventually, it will be determined what percentage of the impurities is held up in the tower reactor itself and immediately associated appurtenances.